

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
8 April 2004 (08.04.2004)

PCT

(10) International Publication Number  
**WO 2004/030129 A3**

(51) International Patent Classification<sup>7</sup>: **G01N 27/64**,  
H01J 49/40

(21) International Application Number:  
PCT/CA2003/001445

(22) International Filing Date:  
23 September 2003 (23.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/413,162 25 September 2002 (25.09.2002) US

(71) Applicant (for all designated States except US): **IONA-  
LYTICS CORPORATION** [CA/CA]; Building M-50,  
IPF, 1200 Montreal Road, Ottawa, Ontario K1A 0R6 (CA).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **GUEVREMONT,  
Roger** [CA/CA]; 2059 Gatineau View Crescent, Ottawa,  
Ontario K1J 7W9 (CA).

(74) Agent: **FREEDMAN, Gordon**; Freedman & Associates,  
117 Centrepointhe Drive, Suite 350, Nepean, Ontario K2G  
5X3 (CA).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,

CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC,  
SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA,  
UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

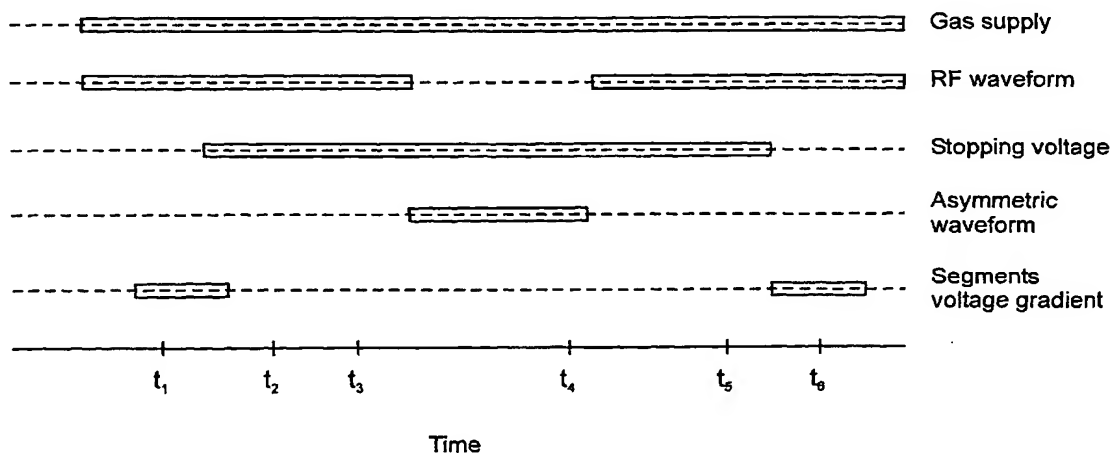
(84) Designated States (regional): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

— as to applicant's entitlement to apply for and be granted  
a patent (Rule 4.17(ii)) for the following designations AE,  
AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA,  
CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES,  
FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,  
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,  
MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH,  
PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN,  
TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO  
patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG,  
ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU,  
TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE,

[Continued on next page]

(54) Title: FAIMS APPARATUS AND METHOD FOR SEPARATING IONS IN THE GAS PHASE



(57) Abstract: A high field asymmetric waveform ion mobility spectrometer (FAIMS) and method for separating ions in the gas phase, the apparatus includes a set of spaced-apart parallel rods, the space between the parallel rods having first and second ends and defines an analyzer region. The apparatus includes an electrical controller for electrically coupling to the set of parallel rods, for applying at least an rf-voltage between the parallel rods of the set of parallel rods in a first operating mode and for applying a combination of an asymmetric waveform voltage and a direct current voltage between the parallel rods of the set of parallel rods in a second operating mode.



DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— of inventorship (Rule 4.17(iv)) for US only

**Published:**

- with international search report  
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:  
3 June 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/CA 03/01445

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 G01N27/64 H01J49/40

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 G01N H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.                      |
|------------|--|--|
| X          | WO 01 69647 A (GUEVREMONT ROGER ; NAT RES COUNCIL CANADA (CA))<br>20 September 2001 (2001-09-20)<br>cited in the application<br><br>page 16, line 30 -page 19, line 14;<br>figures 3,5-8 | 1-6,8,<br>11,12,<br>14,<br>20-22,<br>25,28 |
| A          | WO 01 69221 A (BARNETT DAVID ; PURVES RANDY (CA); GUEVREMONT ROGER (CA); NAT RES C)<br>20 September 2001 (2001-09-20)<br>page 32, line 29 -page 35, line 2; figure 11                    | 15,16,<br>23,24                            |
| A          | US 2002/070338 A1 (LOBODA ALEXANDER V)<br>13 June 2002 (2002-06-13)<br>paragraph '0118!; claim 22; figure 1<br><br>-/--  | 7,9,10                                     |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

12 March 2004

Date of mailing of the international search report

24/03/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax (+31-70) 340-3016

Authorized officer

Klein, M-O

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 03/01445

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No. |
|------------|---|-----------------------|
| A          | <p>GUEVREMONT R ET AL: "Ion trapping at atmospheric pressure (760 Torr) and room temperature with a high-field asymmetric waveform ion mobility spectrometer"<br/>INTERNATIONAL JOURNAL OF MASS SPECTROMETRY, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL,<br/>vol. 193, no. 1,<br/>28 October 1999 (1999-10-28), pages 45-56,<br/>XP004365756<br/>ISSN: 1387-3806<br/>the whole document</p> <p>----</p>      | 14,22,<br>26,27       |
| A          | <p>EICEMAN G A: "Ion-mobility spectrometry as a fast monitor of chemical composition"<br/>TRAC, TRENDS IN ANALYTICAL CHEMISTRY, ANALYTICAL CHEMISTRY. CAMBRIDGE, GB,<br/>vol. 21, no. 4, April 2002 (2002-04),<br/>pages 259-275, XP004371244<br/>ISSN: 0165-9936<br/>the whole document</p> <p>----</p>  | 1-28                  |
| A          | <p>BURYAKOV I A ET AL: "A NEW METHOD OF SEPARATION OF MULTI-ATOMIC IONS BY MOBILITY AT ATMOSPHERIC PRESSURE USING A HIGH-FREQUENCY AMPLITUDE-ASYMMETRIC STRONG ELECTRIC FIELD"<br/>INTERNATIONAL JOURNAL OF MASS SPECTROMETRY AND ION PROCESSES, ELSEVIER SCIENTIFIC PUBLISHING CO. AMSTERDAM, NL,<br/>vol. 128, 1993, pages 143-148, XP000865595<br/>ISSN: 0168-1176<br/>the whole document</p> <p>-----</p> | 1-28                  |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 03/01445

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| WO 0169647                                | A | 20-09-2001          | AU 3907201 A               | 24-09-2001          |
|   |   |                     | AU 3907301 A               | 24-09-2001          |
|   |   |                     | AU 3907401 A               | 24-09-2001          |
|   |   |                     | AU 3907501 A               | 24-09-2001          |
|   |   |                     | AU 3907601 A               | 24-09-2001          |
|   |   |                     | AU 4213701 A               | 24-09-2001          |
|   |   |                     | AU 4213801 A               | 24-09-2001          |
|   |   |                     | AU 4213901 A               | 24-09-2001          |
|   |   |                     | WO 0169216 A2              | 20-09-2001          |
|   |   |                     | WO 0169217 A2              | 20-09-2001          |
|   |   |                     | WO 0169646 A2              | 20-09-2001          |
|   |   |                     | WO 0169218 A2              | 20-09-2001          |
|   |   |                     | WO 0169219 A2              | 20-09-2001          |
|   |   |                     | WO 0169220 A2              | 20-09-2001          |
|   |   |                     | WO 0169647 A2              | 20-09-2001          |
|   |   |                     | WO 0169221 A2              | 20-09-2001          |
|   |   |                     | CA 2401722 A1              | 20-09-2001          |
|   |   |                     | CA 2401735 A1              | 20-09-2001          |
|   |   |                     | CA 2401772 A1              | 20-09-2001          |
|   |   |                     | CA 2401802 A1              | 20-09-2001          |
|   |   |                     | CA 2402628 A1              | 20-09-2001          |
|   |   |                     | CA 2402793 A1              | 20-09-2001          |
|   |   |                     | CA 2402798 A1              | 20-09-2001          |
|   |   |                     | CA 2402812 A1              | 20-09-2001          |
|   |   |                     | EP 1266395 A2              | 18-12-2002          |
|   |   |                     | EP 1273029 A2              | 08-01-2003          |
|   |   |                     | EP 1266393 A2              | 18-12-2002          |
|   |   |                     | EP 1266209 A2              | 18-12-2002          |
|   |   |                     | EP 1266394 A2              | 18-12-2002          |
|   |   |                     | JP 2003527734 T            | 16-09-2003          |
|   |   |                     | US 2003047681 A1           | 13-03-2003          |
|   |   |                     | US 2003089847 A1           | 15-05-2003          |
|   |   |                     | US 2003057369 A1           | 27-03-2003          |
|   |   |                     | US 2003020012 A1           | 30-01-2003          |
|   |   |                     | US 2003089849 A1           | 15-05-2003          |
|   |   |                     | US 2003057367 A1           | 27-03-2003          |
|   |   |                     | US 2003150985 A1           | 14-08-2003          |
|   |   |                     | US 2003038235 A1           | 27-02-2003          |
| WO 0169221                                | A | 20-09-2001          | AU 3907201 A               | 24-09-2001          |
|   |   |                     | AU 3907301 A               | 24-09-2001          |
|   |   |                     | AU 3907401 A               | 24-09-2001          |
|   |   |                     | AU 3907501 A               | 24-09-2001          |
|   |   |                     | AU 3907601 A               | 24-09-2001          |
|   |   |                     | AU 4213701 A               | 24-09-2001          |
|   |   |                     | AU 4213801 A               | 24-09-2001          |
|   |   |                     | AU 4213901 A               | 24-09-2001          |
|   |   |                     | WO 0169216 A2              | 20-09-2001          |
|   |   |                     | WO 0169217 A2              | 20-09-2001          |
|   |   |                     | WO 0169646 A2              | 20-09-2001          |
|   |   |                     | WO 0169218 A2              | 20-09-2001          |
|   |   |                     | WO 0169219 A2              | 20-09-2001          |
|   |   |                     | WO 0169220 A2              | 20-09-2001          |
|   |   |                     | WO 0169647 A2              | 20-09-2001          |
|   |   |                     | WO 0169221 A2              | 20-09-2001          |
|   |   |                     | CA 2401722 A1              | 20-09-2001          |
|   |   |                     | CA 2401735 A1              | 20-09-2001          |
|   |   |                     | CA 2401772 A1              | 20-09-2001          |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Application No

PCT/CA 03/01445

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---------------------|----------------------------|---------------------|
| WO 0169221                                | A                   | CA 2401802 A1              | 20-09-2001          |
|   |                     | CA 2402628 A1              | 20-09-2001          |
|   |                     | CA 2402793 A1              | 20-09-2001          |
|   |                     | CA 2402798 A1              | 20-09-2001          |
|   |                     | CA 2402812 A1              | 20-09-2001          |
|   |                     | EP 1266395 A2              | 18-12-2002          |
|   |                     | EP 1273029 A2              | 08-01-2003          |
|   |                     | EP 1266393 A2              | 18-12-2002          |
|   |                     | EP 1266209 A2              | 18-12-2002          |
|   |                     | EP 1266394 A2              | 18-12-2002          |
|   |                     | JP 2003527734 T            | 16-09-2003          |
|   |                     | US 2003047681 A1           | 13-03-2003          |
|   |                     | US 2003089847 A1           | 15-05-2003          |
|   |                     | US 2003057369 A1           | 27-03-2003          |
|   |                     | US 2003020012 A1           | 30-01-2003          |
|   |                     | US 2003089849 A1           | 15-05-2003          |
|   |                     | US 2003057367 A1           | 27-03-2003          |
|   |                     | US 2003150985 A1           | 14-08-2003          |
|   |                     | US 2003038235 A1           | 27-02-2003          |
|   |                     |                            |                     |
| US 2002070338                             | A1                  | 13-06-2002 CA 2364676 A1   | 08-06-2002          |